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DEVICE SPECIFICATIONS

PXI-5691

RF Amplifier

This document lists specifications for the PXI-5691 RF amplifier.

Specifications are warranted under the following conditions:

- 10 minutes warm-up time
- Calibration cycle maintained
- Chassis fan speed set to High
- PXI-5690 instrument driver used
- PXI-5690 instrument driver self-calibration performed after instrument temperature is stable

Specifications describe the warranted, traceable product performance over ambient temperature ranges of 0 ºC to 55 ºC, unless otherwise noted.

Typical values describe useful product performance beyond specifications that are not covered by warranty and do not include guardbands for measurement uncertainty or drift. Typical values may not be verified on all units shipped from the factory. Unless otherwise noted, typical values cover the expected performance of units over ambient temperature ranges of 23 °C ± 5 °C with a 90% confidence level, based on measurements taken during development or production.

Nominal values (or supplemental information) describe additional information about the product that may be useful, including expected performance that is not covered under *Specifications* or *Typical* values. Nominal values are not covered by warranty.

Specifications are subject to change without notice. For the most recent PXI-5691 specifications, visit *ni.com/manuals*.

National Instruments RF devices are capable of producing and/or acquiring accurate signals within common Medical Implantable Communication System (MICS) frequency bands. NI RF devices are tested and verified in manufacturing for many measurements. For more information about RF device applications, visit *ni.com/global* to contact a National Instruments branch office.

Caution Refer to the *Read Me First: Safety and Electromagnetic Compatibility* document for important safety and electromagnetic compatibility information. To

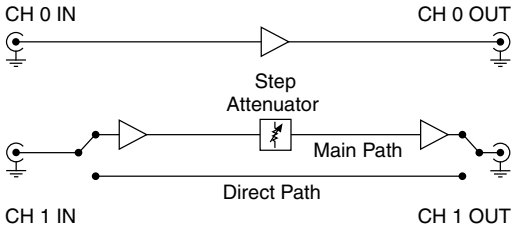
obtain a copy of this document online, visit *ni.com/manuals* and search for the document title.

Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

Caution The input and output connectors on your PXI-5691 are sensitive to electrostatic discharge (ESD). Always observe the safety precautions listed in the *Electrostatic Discharge (ESD) Information* section of the *NI RF Signal Conditioning Devices Getting Started Guide*.

Caution Only apply input signals after you power on the PXI-5691, and remove input signals before you power off the PXI-5691.

Figure 1. PXI-5691 Hardware Block Diagram



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Frequency Range

Frequency range	50 MHz to 8.0 GHz

Channels

Number of channels	2
Gain	
Channel 0	Fixed
Channel 1	Programmable

Channel 0 (CH 0) Performance

Level calibration accuracy[1]	±0.9 dB
Absolute maximum input power (no damage)	+30 dBm typical (7.1 V_{rms}, 10 V_{pk} at 50 Ω)
Maximum reverse power (no damage)	+20 dBm
Maximum output power	+25 dBm
DC voltage at input	±10 V typical
Gain variation by temperature	$(-1.18 \times 10^{-12} \times F) - 0.01$ in dB/°C [2]

[1] Valid for T_{ref} ± 5 °C. For temperatures other than T_{ref}, the level calibration accuracy is valid after applying the gain correction factor for ΔT.

[2] Calculate the correction factor using the following equation:
Δ Gain = (Gain Variation by temperature) * ΔT, where

- $\Delta T = T_{sensor} - T_{ref}$
- T_{sensor} = the temperature reading of the onboard temperature sensor in °C, as reported by the ni5690 Get Temperature VI or the `ni5690_getTemperature` function
- F = frequency, in Hz
- T_{ref} = 34 °C

Table 1. PXI-5691 Channel 0: Gain Warranted Specification

	10 MHz	250 MHz	2 GHz	8 GHz
Gain (Upper Bound) (dB)	33.26	33.22	32.23	30.34
Gain (Lower Bound) (dB)	22.50	22.70	24.10	21.44
The warranted specification is valid only between 10 MHz and 8 GHz. Intermediate bounds can be determined by linearly interpolating the provided data.				

Figure 2. Measured Noise Figure (NF)

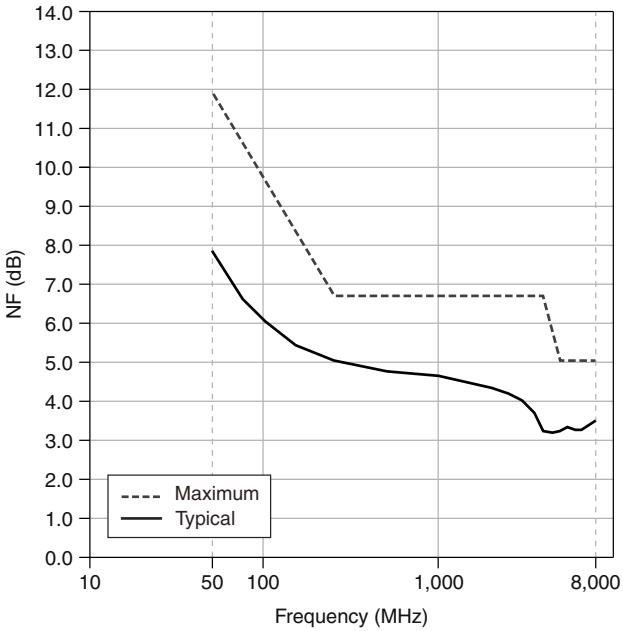


Figure 3. Measured Output Intercept Point (OIP_3)

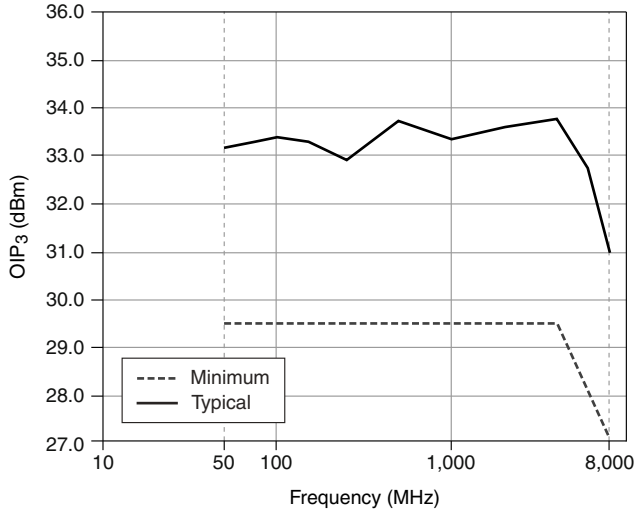


Figure 4. Measured Reverse Gain (S12)

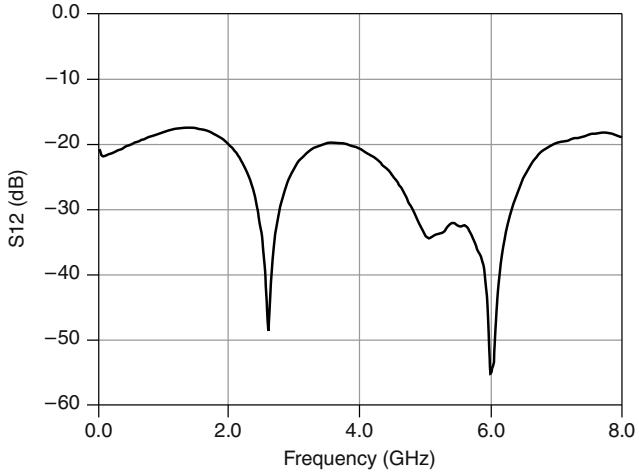


Figure 5. Measured 1 dB Gain Compression

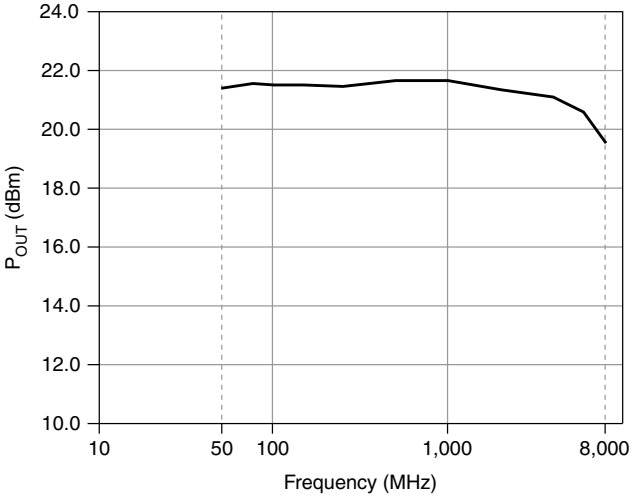


Figure 6. Measured P_{IN} at 1 dB Gain Compression

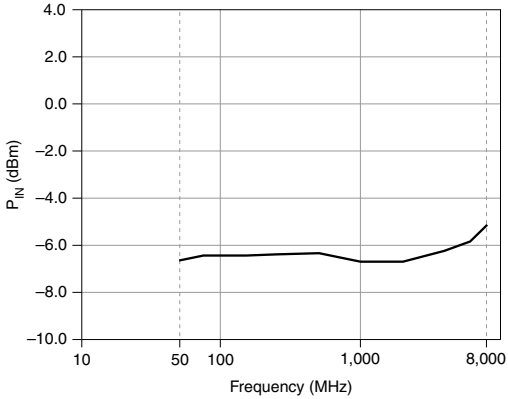


Figure 7. Measured 2nd Harmonic (P_{OUT} = 4 dBm)

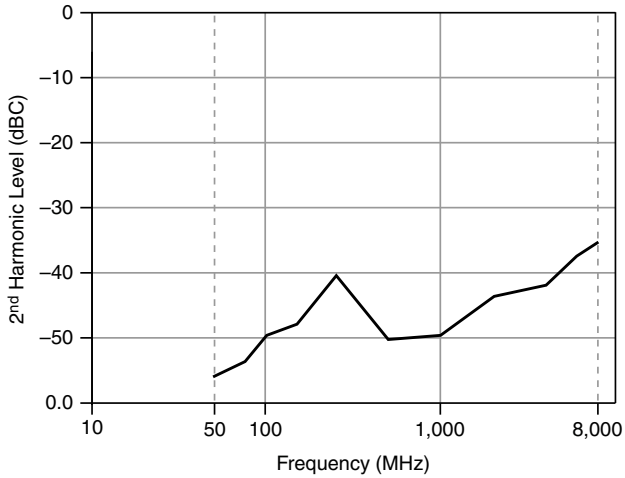
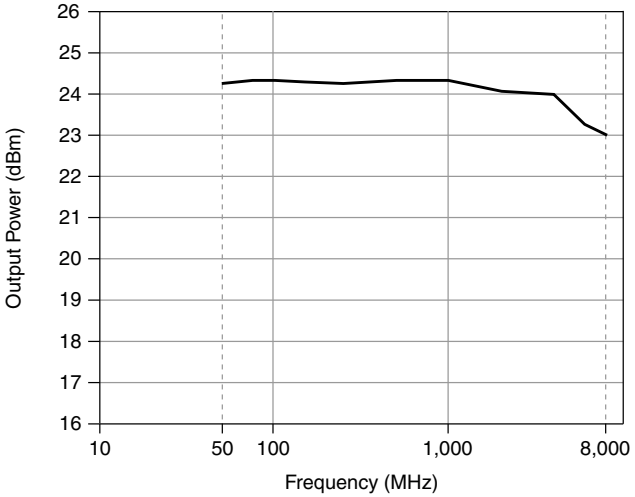


Figure 8. Measured Saturated Output Power



Channel 1 (CH 1)

Main Path

Gain range	+31.5 dB typical
Gain step size	+0.5 dB typical
Level setting time	+4 µs maximum[3]
Level calibration accuracy	±0.9 dB[4]
Absolute maximum input power (no damage)	+30 dBm typical (7.1 V_{rms}, 10 V_{pk} at 50 Ω)
Maximum reverse power (no damage)	+20 dBm
Maximum output power	+25 dBm
DC voltage at input	±10 V typical
Gain variation by temperature	$(-1.34 \times 10^{-12} \times F)$ -0.01 in dB/°C [5]

Table 2. PXI-5691 Channel 1: Programmable Gain Warranted Specification

	10 MHz	3.25 GHz	4 GHz	8 GHz
Maximum Gain (Upper Bound) (dB)	34.10	27.57	27.15	24.27
Maximum Gain (Lower Bound) (dB)	23.60	18.85	18.71	15.40
Minimum Gain (Upper Bound) (dB)	3.96	-2.96	-4.52	-6.14

[3] The level settling time is measured to 0.5 dB of final value when switching from minimum to maximum gain. Achieving settling times closer to the final attenuation value may take substantially longer.

[4] Valid for T_{ref} ± 5 °C. For temperatures other than T_{ref}, the level calibration accuracy is valid after applying the gain correction factor for ΔT.

[5] Calculate the correction factor using the following equation:
Δ Gain = (Gain Variation by temperature) * ΔT, where

- $\Delta T = T_{sensor} - T_{ref}$
- T_{sensor} = the temperature reading of the onboard temperature sensor in °C, as reported by the ni5690 Get Temperature VI or the `ni5690_getTemperature` function
- T_{ref} = 34 °C
- F = frequency, in Hz

Table 2. PXI-5691 Channel 1: Programmable Gain Warranted Specification (Continued)

	10 MHz	3.25 GHz	4 GHz	8 GHz
Minimum Gain (Lower Bound) (dB)	-7.00	-11.90	-12.65	-16.53
The warranted specification is valid only between 10 MHz and 8 GHz. Intermediate bounds can be determined by linearly interpolating the provided data.				

Figure 9. Average Measured Input and Output VSWR at Maximum Gain Setting

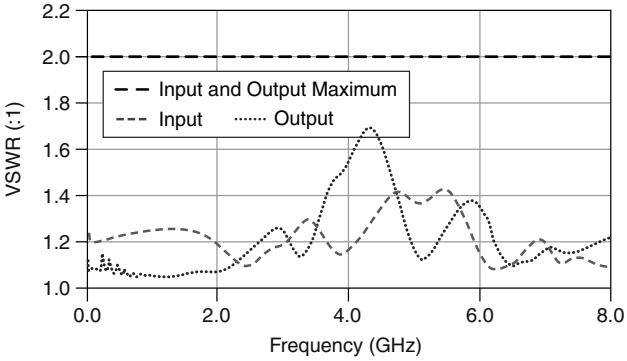


Figure 10. Average Measured Input and Output VSWR at Minimum Gain Setting

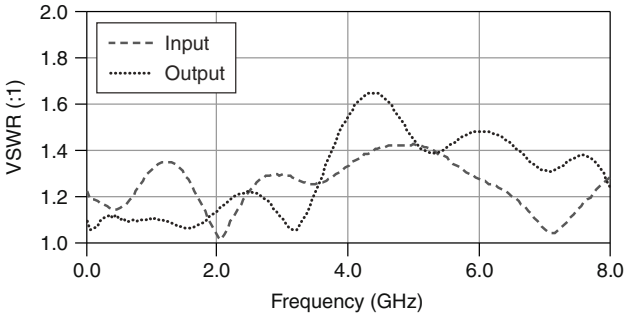


Figure 11. Measured Noise Figure (NF)

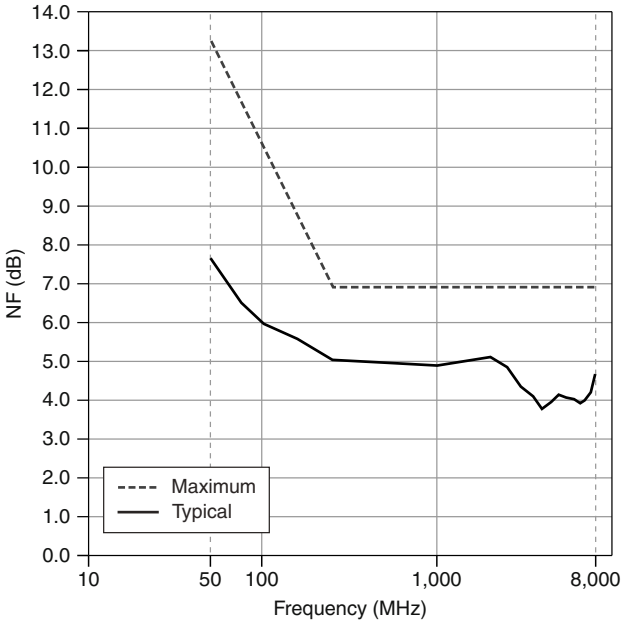


Figure 12. Measured Output Intercept Point (OIP_3)

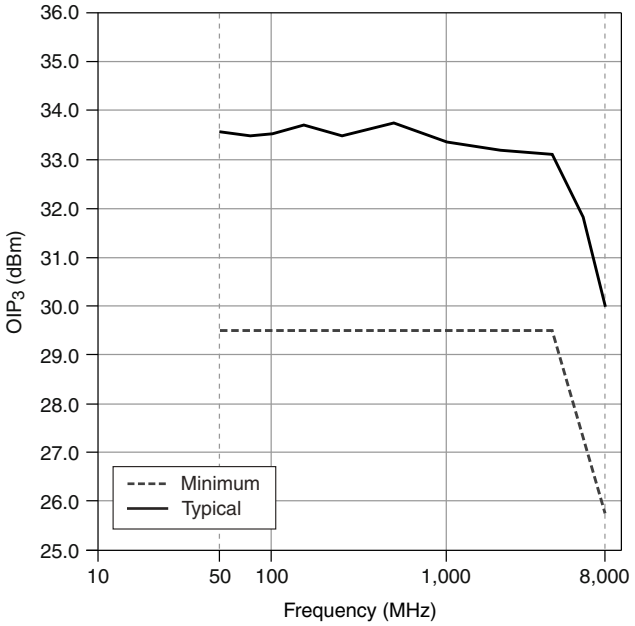


Figure 13. Measured Saturated Output Power (P_{SAT} at Maximum Gain Setting)

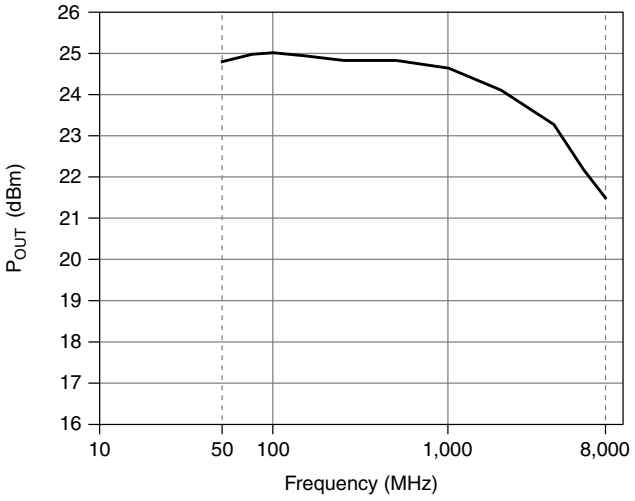


Figure 14. Measured Reverse Gain (S12) at Maximum Gain Setting

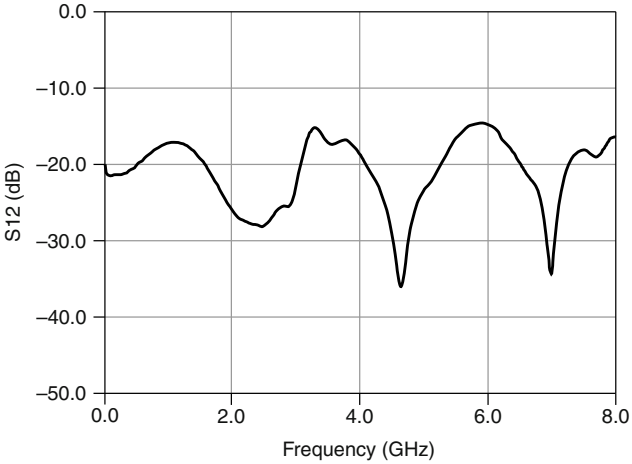


Figure 15. Measured 1 dB Gain Compression

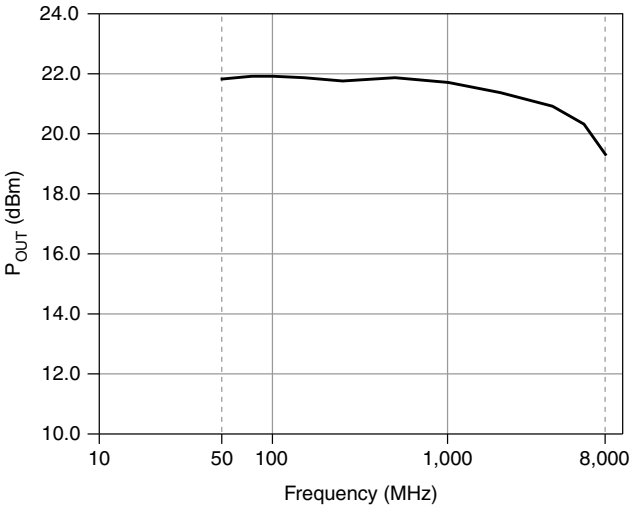


Figure 16. Measured P_{IN} at 1 dB Gain Compression

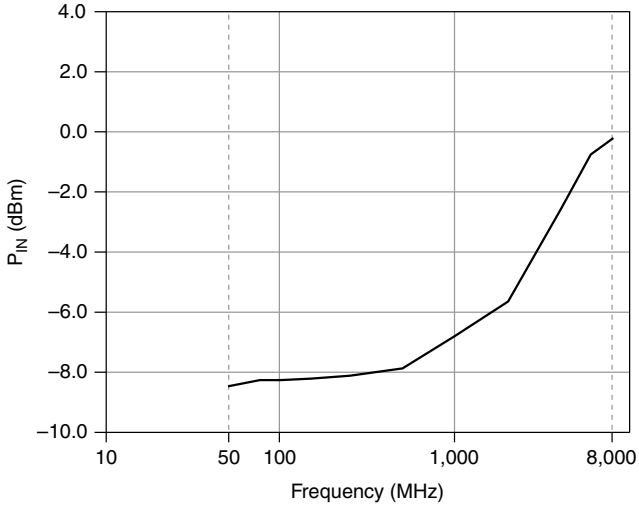
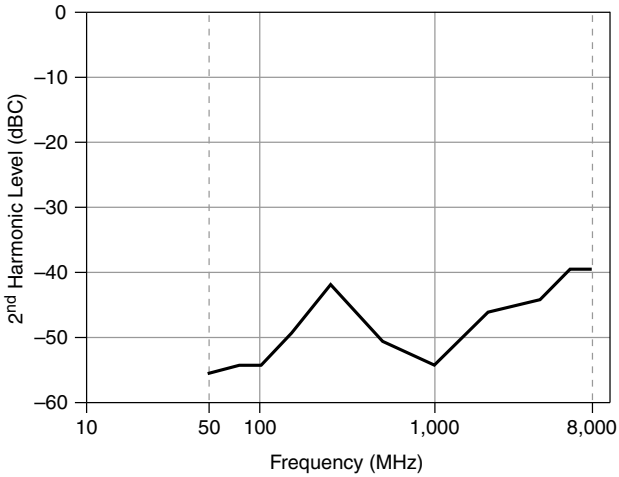


Figure 17. Measured 2nd Harmonic (P_{OUT} = 4 dBm, Maximum Gain Setting)



Direct Path

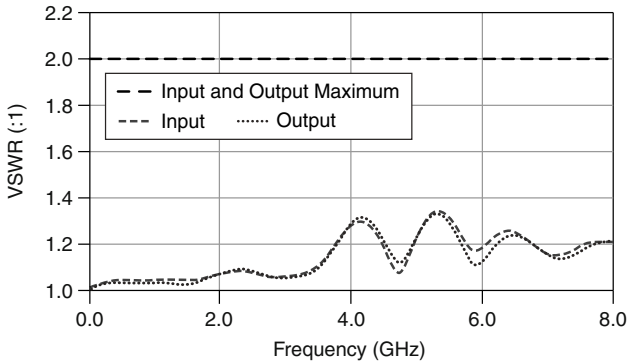
Level calibration accuracy	±0.9 dB[6]
Maximum input power (no damage)	+30 dBm typical (7.1 V_{rms}, 10 V_{pk} at 50 Ω)
DC voltage at input	±10 V typical[7]
Relay switch time	5 ms maximum
Gain variation by temperature	$(-1.34 \times 10^{-12} \times F) - 0.01$ in dB/°C [8]

Direct Path Performance

Table 3. PXI-5691 Channel 1: Direct Path Gain

Frequency	10 MHz	8 GHz
Gain (Upper Bound) (dB)	0.40	-0.60
Gain (Lower Bound) (dB)	-0.60	-3.40

Figure 18. Average Measured Input and Output VSWR



[6] Valid for T_{ref} ± 5° C. For temperatures other than T_{ref}, the level calibration accuracy is valid after applying the gain correction factor for ΔT.

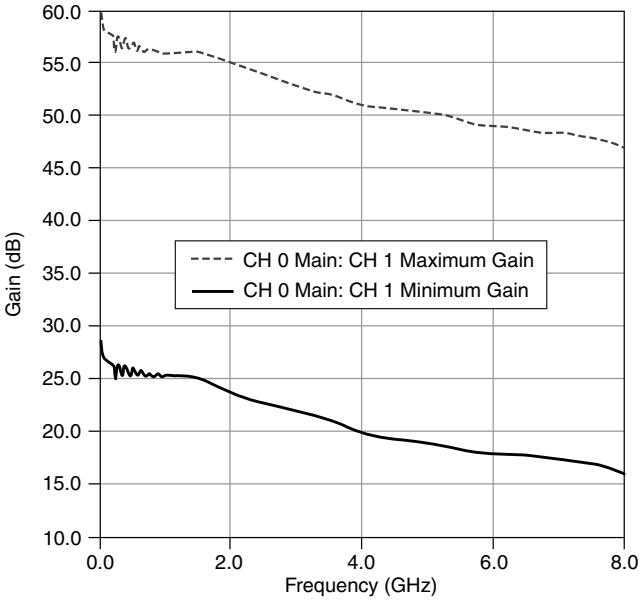
[7] DC coupled for input to output, but only calibrated from 50 MHz to 8 GHz.

[8] Calculate the correction factor using the following equation:
Δ Gain = (Gain Variation by temperature) * ΔT, where

- $\Delta T = T_{sensor} - T_{ref}$
- T_{sensor} = the temperature reading of the onboard temperature sensor in °C, as reported by the ni5690 Get Temperature VI or the `ni5690_getTemperature` function
- T_{ref} = 34°C
- F = frequency, in Hz

Channel 0/Channel 1 Cascaded Path Performance

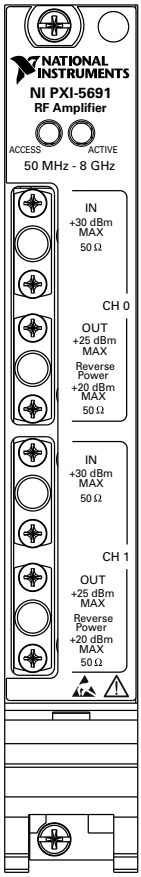
Figure 19. Average Measured Cascaded Gain Response



Note When cascading Channel 0 and Channel 1, each channel is individually calibrated.

Hardware Front Panel

Figure 20. PXI-5691 RF Amplifier Front Panel



CH 0 IN	
Connector	SMA female
Impedance	50 Ω
Coupling	AC
Input amplitude	+30 dBm maximum

CH 0 OUT	
Connector	SMA female
Impedance	50 Ω
Coupling	AC
Output amplitude	+25 dBm maximum
CH 1 IN	
Connector	SMA female
Impedance	50 Ω
Coupling[9]	AC
Input amplitude	+30 dBm maximum
CH 1 OUT	
Connector	SMA female
Impedance	50 Ω
Coupling	AC
Output amplitude	+25 dBm maximum

Power Requirements

Table 4. Power and Current

Power Rail (V_{DC})	Maximum Current (mA)	Typical Current (mA)	Maximum Power (W)
+3.3	643	234	2.1
+5	1,382	1,310	6.9
+12	240	99	2.9
-12	28	12	0.34

Calibration

Interval	1 year

[9] Direct path passes input DC level to output.

Physical Characteristics

Dimensions	3U, One Slot, PXI/cPCI Module 21.6 × 2.0 × 13.0 cm (8.5 × 0.8 × 5.1 in.)
Weight	263 g (9.2 oz)

Environment

Maximum altitude	2,000 m (at 25 °C ambient temperature)
Pollution Degree	2

Indoor use only.

Operating Environment

Ambient temperature range	0 °C to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Relative humidity range	10% to 90%, noncondensing (Tested in accordance with IEC-60068-2-56.)

Storage Environment

Ambient temperature range	-40 °C to 70 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.)
Relative humidity range	5% to 95%, noncondensing (Tested in accordance with IEC-60068-2-56.)
Operational shock	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.)
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g_{rms}
Nonoperating	5 Hz to 500 Hz, 2.4 g_{rms} (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

Compliance and Certifications

Safety

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia, and New Zealand (per CISPR 11), Class A equipment is intended for use only in heavy-industrial locations.

Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treament of material or inspection/analysis purposes.

Note For EMC declarations and certifications, refer to the *Online Product Certification* section.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

To obtain product certifications and the DoC for this product, visit *ni.com/certification*, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *Minimize Our Environmental Impact* web page at *ni.com/environment*. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)



EU Customers At the end of the product life cycle, all products must be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit *ni.com/environment/weee.htm*.

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